PATENT ABSTRACTS OF JAPAN

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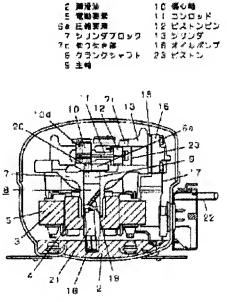
(71)Applicant : MATSUSHITA REFRIG CO LTD
(72)Inventor : HORIGUCHI TAKAFUMI
OTA TOSHIHIKO
ISHIDA TAKANORI
IDE TERUMASA
NAGAO TAKAHIDE
KATAYAMA MAKOTO

(54) HERMETIC ELECTRIC COMPRESSOR

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent lowering of efficiency in a hermetic electric compressor by increasing lubrication quantity between a piston and a cylinder and lowering a leak loss when compressing.
SOLUTION: An annular lubrication groove 23e is recessingly formed on outer periphery of the piston 23 and is set to come out of a semi-circular cutout part 7c at the bottom dead center. Thereby lubricant is stably fed between the piston and the cylinder when operating at a low speed.



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CLAIMS

[Claim(s)]
[Claim 1]An encapsulated type electrically-driven compressor cutting in a periphery of said piston an approximately annular oil supply groove which is [both] open for free passage in it being characterized by comprising the following in said well-closed container via said notch near the bottom dead point of said piston.
In a well-closed container, it is a lubricating oil.
A motor element operated with two or more operation frequency containing number of rotations of less than commercial power frequency.
A crankshaft having a lubricating oil pump which accommodates a compression element driven with said motor element, comprises a principal axis and an eccentric shaft, and is open for free passage to said eccentric shaft via an oil passage.
A cylinder block which said principal axis is supported pivotally, enabling free rotation, and has compression space, A semicircular arc notch section for a piston which goes and comes back to inside of said compression space, and a connecting rod which transmits rotational movement of said eccentric shaft to said piston via a piston pin being included in said compression element, and inserting said piston pin in said compression space upper wall of said cylinder block.

[Claim 2]The encapsulated type electrically-driven compressor according to claim 1 making a height position which faces a notch section carry out the opening of the lubricating oil discharge hole formed in the eccentric shaft upper part of a crankshaft.
[Claim 3]The encapsulated type electrically-driven compressor according to claim 1 or 2 by which number of rotations not more than 35r/sec being included in operation frequency.
[Claim 4]The encapsulated type electrically-driven compressor according to claim 3 cutting at least one or more annular grooves between end faces of an oil supply groove and said piston.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates especially to efficient-ization of a low speed driving time about the encapsulated type electrically-driven compressor of the inverter control system used for an electric refrigerator, an air conditioner, etc.
[0002]
[Description of the Prior Art]In recent years, in a refrigerator, an air conditioner, etc., reduction of amount of used electricity is demanded strongly, and efficient-ization in the time of a low speed rotary has been SUBJECT in the inverter control-type encapsulated type electrically-driven compressor now.
[0003]There are some which are shown in JP,2000-145637,A as a conventional encapsulated type electrically-driven compressor.
[0004]Hereafter, the encapsulated type electrically-driven compressor of the above-mentioned conventional technology is explained, referring to Drawings. An up-and-down relation is based on the state where the encapsulated type electrically-driven compressor was installed in the regular posture, in the following explanation.
[0005]Drawing 6 shows the sectional view of the encapsulated type electrically-driven compressor of conventional technology, and the operation frequency and the efficiency characteristic figure of an encapsulated type electrically-driven compressor of the former [drawing 7].
[0006]In drawing 6, 1 is a well-closed container, consists of the stator 3 and the rotator 4, and accommodates the motor element 5 which rotates with an inverter control system, and the compression element 6 driven with the motor element 5. 2 is the lubricating oil stored in the well-closed container 1.
[0007]Next, the details of the compression element 6 are explained below. 7 forms the cylinder 13 with a cylinder block. 8 is a crankshaft, it comprises the principal axis 9 and the eccentric shaft 10, and the lubricating oil pump which is open for free passage to the upper bed of the eccentric shaft 10 via an oil supply passage is built in, and the opening of the lower end is carried out into the lubricating oil 2. 11 has connected the eccentric shaft 10 and the piston 14 via the piston pin 12 with the connecting rod. The valve plate in which 15 was provided with the suction hole, the suction valve, the discharge opening, and the regurgitation valve (neither is illustrated), and 16 are the cylinder heads divided into the inside at the inhalatorium and the regurgitation room (neither is illustrated), and 17 is a suction muffler. 7a is a slot of the shape of an abbreviated U character which carries out an opening to the cylinder 13 from the upper wall of the cylinder block 7.
The connecting rod 11 connected with the piston inserted into the **** compression space 13 and the eccentric shaft 10 is aligned mutually, the piston pin 12 is inserted using the slot 7a, and both are assembled.

[0008]About the encapsulated type electrically-driven compressor constituted as mentioned above, the operation is explained below.

[0009]The rotator 4 of the motor element 5 is that rotate the crankshaft 8 and movement of the eccentric shaft 10 is told to the piston 14 via the connecting rod 11, The inside of the compression space 13 is moved reciprocately, said refrigerant gas drawn in the well-closed container 1 through the suction tube 22 is inhaled from the opening of the suction muffler 17, and the piston 14 is continuously compressed within the cylinder 13. On the other hand, the lubricating oil 2 is attracted by the lubricating oil pump 18, the crankshaft 8 is led upwards from the spiral slot 19 by it with rotation, and a lubricating oil is injected towards the slot 7a of the shape of the lubricating oil discharge hole 10b to an abbreviated U character provided in the upper bed of the eccentric shaft 10 through the open hole 20. In this way, the injected lubricating oil is equivalent to the upper surface of the piston 14, and manages the lubrication and seal between the piston 14 and the compression space 13.
[0010]Since it is not necessary to divide the connecting rod 11 in order to assemble the above conventional composition using the abbreviated U character-like slot 7a,-izing can be carried out [low cost], and also there is a merit that mass production nature is good.
[0011]As another conventional example, the method of dividing and assembling a connecting rod is shown without providing an abbreviated U character-like slot in a cylinder, and since the sealing nature between a piston and a cylinder is secured, in low speed driving, this method has the merit that efficiency cannot fall easily.
[0012]
[Problem to be solved by the invention]However, in order to provide an abbreviated U character-like slot in a cylinder, the sealing nature between a piston and a cylinder worsens, and the above-mentioned conventional composition. In a low speed driving time, since the amount of oil supply into a cylinder and the quantity of the lubricating oil injected from the lubricating oil discharge hole of an eccentric shaft decrease, the oil seal nature between a piston and a cylinder gets extremely bad, and there is a fault that efficiency falls.
[0013]In drawing 7, as for a horizontal axis, a vertical axis shows the operating efficiency of a compressor by coefficient-of-performance COP (W/W) with the operation frequency of a compressor. COP shows the characteristic which has the maximal value to operation frequency, and serves as the greatest value in about 40 - 45r/sec. It turns out at the time of low rotation that the operating efficiency of an encapsulated type palace compressor falls remarkably especially at the time of the low rotation not more than 35r/sec. This is considered to be based on the increase in the sliding loss due to the refrigerating capacity fall by the leak of the compressed gas from compression space, or the fall of lubricating oil pump capability.
[0014]On the other hand, since it is not necessary to divide a connecting rod and the assembly ****** does not need to provide an abbreviated U character-like slot in a cylinder, there is a merit that oil seal nature cannot fall easily at a low speed driving time, but since assembly nature is bad and part mark also have it, there is a fault that cost becomes high. [many]
[0015]This invention solves SUBJECT of these former, and it is low cost and aims at providing the encapsulated type electrically-driven compressor which can raise the efficiency at the time of a low speed rotary in the good U character-like slot system of assembly nature.
[0016]
[Means for solving problem]The motor element operated with two or more operation frequency which the invention of this invention according to claim 1 consists of a stator and a rotator, and contains the number of rotations of less than commercial power frequency, Support pivotally the principal axis of the crankshaft having the lubricating oil pump which accommodates the compression element driven with the motor element, comprises a principal axis and an eccentric shaft, and is open for free passage to an upside eccentric shaft via an oil supply passage, and a crankshaft, and. Because equip the upper wall of compression space with the cylinder block which has semicircular arc compression space and a crankshaft rotates with a motor element. Make a lubricating oil inject towards the semicircular arc notch section which attracted the lubricating oil and was provided in the cylinder block from the upside eccentric shaft, and. Cut an annular oil supply groove in the periphery of a piston, and by a piston bottom dead point. By having set up so that an annular oil supply groove might come out of a semicircular arc notch section, when a piston is a bottom dead point, an oil supply groove is covered with a lubricating

oil, and it always has the operation of sending in a lubricating oil between a piston and a cylinder, at the time of compression (top dead center).

[0017]The invention of this invention according to claim 2 a lubricating oil discharge hole formed in the eccentric shaft upper part of a crankshaft to the invention according to claim 1, A lubricating oil injected from a lubricating oil discharge hole of an eccentric shaft by having provided in a position of the same height as a semicircular arc notch section provided in a upper wall of compression space of a cylinder block on a wall surface of a semicircular arc notch section by that of direct this slack. Quantity of a lubricating oil led to an annular oil supply groove cut in a piston periphery increases, and it has the operation that the amount of oil supply between a piston and a cylinder increases.

[0018]The invention of this invention according to claim 3 Claim 1. Or it is a case where it is operated with two or more operation frequency which contains number of rotations not more than 35r/sec in the invention according to claim 2, Sealing nature in compression space of supplying with oil certainly between a piston and a cylinder has especially the operation which suppresses a leak of compressed gas of ****** at a low speed driving time not more than 35r/sec.

[0019]The invention of this invention according to claim 4 establishes further two or more annular oil supply grooves cut in a piston in the invention according to claim 3, and. By having set up so that two or more annular oil supply grooves might come out from a semicircular arc notch section provided in a cylinder upper wall of a cylinder block by a bottom dead point. Since two or more cut oil supply grooves are covered with a lubricating oil in a bottom dead point of a piston, it has the operation that sealing nature between a piston and a cylinder improves more, rather than a case of one oil supply groove.

[0020]

[Mode for carrying out the invention]Hereafter, the embodiment of the encapsulated type electrically-driven compressor by this invention is described, referring to Drawings. About the former and an identical configuration, identical codes are attached and detailed explanation is omitted.

[0021](Embodiment 1) Drawing 1 is a view figure [in / the sectional view of the encapsulated type electrically-driven compressor by the embodiment of the invention 1 and drawing 2 can be set in an important section sectional view, and / in drawing 3 / the V-V' line of drawing 2].

[0022]In drawing 1, 1 is a well-closed container and accommodates the motor element 5 which consists of the stator 3 and the rotator 4, and the compression element 6a driven with the motor element 5.

[0023]Next, the details of the compression element 6a are explained below. 7 is a cylinder block and forms the cylinder 13. 8 is a crankshaft, it comprises the principal axis 9 and the eccentric shaft 10, and the lubricating oil pump 18 which is open for free passage to the upper bed of the eccentric shaft 10 via an oil supply passage is built in, and the opening of the lower end is carried out into the oil 2. 11 has connected the eccentric shaft 10 and the piston 23 via the piston pin 12 with the connecting rod. 7a is a slot of the shape of an abbreviated U character which carries out an opening to the cylinder 13 from the upper wall of the cylinder block 7, The connecting rod 11 connected with the piston 23 inserted into the **** compression space 13 and the eccentric shaft 10 is aligned mutually, the piston pin 12 is inserted using the slot 7a, and both are assembled.

[0024]As shown in the eccentric shaft 10 at drawing 2 and drawing 3, the semicircular arc notch section 7c provided in the cylinder 13 is faced, and 10 d of lubricating oil discharge holes are provided in the position of the same height. 20 is the open hole established in the inside of the eccentric shaft 10, one end carries out an opening to the upper bed of the eccentric shaft 10, and the other end is open for free passage to the inclined passage 21 and the lubricating oil pump 18 by the spiral slot 19 formed in the periphery of the principal axis 9. As shown in drawing 4, have cut the annular oil supply groove 23e in the piston 23 at the periphery, and in a bottom dead point. The annular oil supply groove 26e comes out from the semicircular arc notch section 7c thoroughly, and in the time of compression (near a top dead center), the annular oil supply groove 23e has set up go into the semicircular arc notch section 7c thoroughly.

[0025]15 is the valve plate provided with the suction hole, the suction valve, the discharge opening, and the regurgitation valve (neither is illustrated), and closes the end face of the cylinder 13. 16 is the cylinder head divided into the inside at the inhalatorium and the regurgitation room (neither is illustrated), and is fixed to the anti-cylinder 12 side of the valve plate 15. 17 is a suction muffler and is located under the cylinder block 7, It is fixed by being pinched by the valve plate 15 and the cylinder head 16, one end is open for free passage in a cylinder via the valve plate 15, and the other end passes to the opening provided in about 22 suction tube provided in the well-closed container 1. While being fixed to the well-closed container 1 with a suction tube, it is connected to the low-tension side (not shown) of a refrigerating cycle, and 22 draws a refrigerant gas (not shown) in the well-closed container 1.
[0026]About the constituted above encapsulated type electrically-driven compressors, the operation is explained below. The rotator 4 of the motor element 5 rotates the crankshaft 8, and the piston 23 moves the inside of the cylinder 13 reciprocately by movement of the eccentric shaft 10 being told to the piston 23 via the connecting rod 11, Said refrigerant gas drawn in the well-closed container 1 through the suction tube 22 is inhaled from the opening of the suction muffler 17, and is continuously compressed within the cylinder 13.
[0027]On the other hand, if the crankshaft 8 rotates with the motor element 5, the lubricating oil 2 will go up by rotation of the siphon pump 18, and a lubricating oil will be led to the eccentric shaft 10 via the spiral slot 19 and the open hole 20 by a pump action of the inclined passage 21. A lubricating oil led into the eccentric shaft 10 is injected according to a centrifugal force from 10d of lubricating oil discharge holes provided in the eccentric shaft 10. After a lubricating oil injected from 10d of lubricating oil discharge holes hits a side attachment wall of the semicircular arc notch section 7c provided in a upper wall of the cylinder 13 of the cylinder block 7, it flows into the piston upper surface, falls, and carries out the lubrication of between a piston and cylinders.
[0028]In this invention, cut the annular oil supply groove 23e in a periphery of the piston 23, and. By a bottom dead point of a piston, the annular oil supply groove 23e comes out of the semicircular arc notch section 7c provided in the cylinder 13 of the cylinder block 7, and. Since it has set up so that the annular oil supply groove 23e may go into the semicircular arc notch section 7c thoroughly at the time of compression, After a lubricating oil injected from the lubricating oil discharge hole 10b of the eccentric shaft 10 hits the semicircular arc notch section 7c, a lubricating oil is always led to the upper surface of a piston, and. By a bottom dead point of a piston, the annular oil supply groove 23e established in an outer peripheral part of the piston 23 is always covered with a lubricating oil, and at the time of compression. Since the annular oil supply groove 23e enters into the semicircular arc notch section 7c (compression space), it can stop that sealing nature between a piston and a cylinder improves and compressed gas in compression space leaks to the low-tension side in a well-closed container.
[0029]setting to drawing 2 and drawing 3 furthermore -- 10 d of lubricating oil discharge holes of the eccentric shaft 10 -- the semicircular arc notch 7c -- relativity -- in a position. And since the lubricating oil injected from the oil discharge hole 10b of the eccentric shaft 10 since it had provided in the same height is always equivalent to the wall surface of the semicircular arc notch 7c, flows into the piston upper surface and falls, The annular oil supply groove 23e cut in the piston 23 is covered with a lubricating oil, and the amount of oil supply between a piston and a cylinder can be increased. The lubricating oil injected from the lubricating oil discharge hole 10b of the eccentric shaft 10 by attaching the angle of about 5-10 degrees to a hand of cut and an opposite direction at 10 d of lubricating oil discharge holes had been equivalent to the semicircular arc notch section 7c wall surface in the piston top dead center conventionally (when an angle is not attached), but. By attaching the angle of about 5-10 degrees, since a lubricating oil always comes to be equivalent to the wall surface of the semicircular arc notch section 7c when a piston is a bottom dead point, the amount of oil supply can be increased further.
[0030]Drawing 4 is operation frequency and an efficiency characteristic figure of an encapsulated type electrically-driven compressor in the embodiment of the invention 1.
[0031]In drawing 4, as for a horizontal axis, a vertical axis shows operating efficiency of an

encapsulated type electrically-driven compressor by coefficient-of-performance COP (W/W) with operation frequency of an encapsulated type electrically-driven compressor. An encapsulated type electrically-driven compressor of the former [dashed line] and a solid line show the characteristic of an encapsulated type electrically-driven compressor of this invention, respectively. Although COP has the maximal value to operation frequency in both sides, the characteristic which is excellent in a coefficient of performance of a compressor of this invention covering whole drive frequency, and excelled about 35 (r/sec) in this invention by a difference of both characteristics becoming large at the time of low rotation is seen.

[0032]Since quantity of a lubricating oil which oil supply capability of a lubricating oil pump declines, and is injected from 10d of lubricating oil discharge holes of the eccentric shaft 10 when number of rotations becomes low will also become less by inverter control of a compressor if it operates at number of rotations not more than 35r/sec, oil seal nature between a piston and a cylinder gets worse. Since the compression time required is prolonged because period time of piston reciprocation becomes long, the amount of leaks of compressed gas of compression space also increases, Although compressor efficiency falls from a fall of refrigerating capacity, since the amount of oil supply of a between [piston cylinders] can be increased also in the time of a low speed by ensuring oil supply to a notch section and cutting an oil supply groove in a piston periphery, operating efficiency of a compressor improves.

[0033](Embodiment 2) Drawing 5 is an enlarged drawing of a piston of an encapsulated type electrically-driven compressor in the embodiment of the invention 2. 23a is a piston and two or more annular oil supply grooves 23e on a periphery near the end face with grooving. Since it has set up by a bottom dead point of a piston so that two or more oil supply grooves 23e may come out, Since two or more crevices are covered with it in a bottom dead point after a lubricating oil injected from that of the eccentric shaft 10 is equivalent to a wall surface of the semicircular arc notch 7c, the sealing nature of compression space improves more by increasing further the amount of oil supply to a piston and a cylinder.

[0034]

[Effect of the Invention]As explained above, the invention according to claim 1, The motor element operated with two or more operation frequency which consists of a stator and a rotator and contains the number of rotations of less than commercial power frequency, Support pivotally the principal axis of the crankshaft having the lubricating oil pump which accommodates the compression element driven with the motor element, comprises a principal axis and an eccentric shaft, and is open for free passage to an upside eccentric shaft via an oil supply passage, and a crankshaft, and. Because have the cylinder block which has semicircular arc compression space above compression space and a crankshaft rotates with a motor element. Make a lubricating oil inject towards the semicircular arc notch section provided in the cylinder block from the lubricating oil discharge hole which attracted the lubricating oil and was provided in the upside eccentric shaft, and. An annular oil supply groove is cut in the periphery of a piston, and by a piston bottom dead point, by having set up so that an annular oil supply groove might come out of a semicircular arc notch, by an oil supply groove, since it can supply with oil between a piston and a cylinder, sealing nature can be secured and efficiency always improves.

[0035]When the invention according to claim 2 provided the lubricating oil discharge hole formed in the eccentric shaft upper part of a crankshaft at the invention according to claim 1 in the position of the same height as the semicircular arc notch section provided in the upper wall of the compression space of a cylinder block, Since the lubricating oil injected from the lubricating oil discharge hole always hits a semicircular arc notch section, the quantity of the lubricating oil with which the annular oil supply groove cut in the piston is covered increases, the amount of oil supply between a piston and a cylinder increases, and efficiency increases.

[0036]With two or more operation frequency which contains the number of rotations not more than 35r/sec in the invention according to claim 1 or 2, the invention of this invention according to claim 3 is a case where it is operated, and by invention of Claim 1 and Claim 2. Since the amount of oil supply between a piston and a cylinder can be increased at the low speed driving time not more than 35r/sec, the efficiency of a low speed driving time improves.

[0037]The invention according to claim 4 establishes further two or more annular oil supply

grooves cut in the piston in the invention according to claim 3, and. By having set up so that two or more annular oil supply grooves might come out from the semicircular arc notch section provided in the cylinder upper wall of the cylinder block by a bottom dead point. In the bottom dead point of a piston, two or more cut oil supply grooves are covered with a lubricating oil, and at the time of compression, since the amount of oil supply of a between [a cylinder and pistons] increases further, efficiency increases.

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TECHNICAL FIELD

[Field of the Invention]This invention relates especially to efficient-ization of a low speed driving time about the encapsulated type electrically-driven compressor of the inverter control system used for an electric refrigerator, an air conditioner, etc.

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PRIOR ART

[Description of the Prior Art]In recent years, in a refrigerator, an air conditioner, etc., reduction of amount of used electricity is demanded strongly, and efficient-ization in the time of a low speed rotary has been SUBJECT in the inverter control-type encapsulated type electrically-driven compressor now.
[0003]There are some which are shown in JP,2000-145637,A as a conventional encapsulated type electrically-driven compressor.
[0004]Hereafter, the encapsulated type electrically-driven compressor of the above-mentioned conventional technology is explained, referring to Drawings. An up-and-down relation is based on the state where the encapsulated type electrically-driven compressor was installed in the regular posture, in the following explanation.
[0005]Drawing 6 shows the sectional view of the encapsulated type electrically-driven compressor of conventional technology, and the operation frequency and the efficiency characteristic figure of an encapsulated type electrically-driven compressor of the former [drawing 7].
[0006]In drawing 6, 1 is a well-closed container, consists of the stator 3 and the rotator 4, and accommodates the motor element 5 which rotates with an inverter control system, and the compression element 6 driven with the motor element 5. 2 is the lubricating oil stored in the well-closed container 1.
[0007]Next, the details of the compression element 6 are explained below. 7 forms the cylinder 13 with a cylinder block. 8 is a crankshaft, it comprises the principal axis 9 and the eccentric shaft 10, and the lubricating oil pump which is open for free passage to the upper bed of the eccentric shaft 10 via an oil supply passage is built in, and the opening of the lower end is carried out into the lubricating oil 2. 11 has connected the eccentric shaft 10 and the piston 14 via the piston pin 12 with the connecting rod. The valve plate in which 15 was provided with the suction hole, the suction valve, the discharge opening, and the regurgitation valve (neither is illustrated), and 16 are the cylinder heads divided into the inside at the inhalatorium and the regurgitation room (neither is illustrated), and 17 is a suction muffler. 7a is a slot of the shape of an abbreviated U character which carries out an opening to the cylinder 13 from the upper wall of the cylinder block 7.
The connecting rod 11 connected with the piston inserted into the **** compression space 13 and the eccentric shaft 10 is aligned mutually, the piston pin 12 is inserted using the slot 7a, and both are assembled.

[0008]About the encapsulated type electrically-driven compressor constituted as mentioned above, the operation is explained below.
[0009]The rotator 4 of the motor element 5 is that rotate the crankshaft 8 and movement of the eccentric shaft 10 is told to the piston 14 via the connecting rod 11, The inside of the compression space 13 is moved reciprocately, said refrigerant gas drawn in the well-closed container 1 through the suction tube 22 is inhaled from the opening of the suction muffler 17, and the piston 14 is continuously compressed within the cylinder 13. On the other hand, the lubricating oil 2 is attracted by the lubricating oil pump 18, the crankshaft 8 is led upwards from

the spiral slot 19 by it with rotation, and a lubricating oil is injected towards the slot 7a of the shape of the lubricating oil discharge hole 10b to an abbreviated U character provided in the upper bed of the eccentric shaft 10 through the open hole 20. In this way, the injected lubricating oil is equivalent to the upper surface of the piston 14, and manages the lubrication and seal between the piston 14 and the compression space 13.

[0010]Since it is not necessary to divide the connecting rod 11 in order to assemble the above conventional composition using the abbreviated U character-like slot 7a,-izing can be carried out [low cost], and also there is a merit that mass production nature is good.

[0011]As another conventional example, the method of dividing and assembling a connecting rod is shown without providing an abbreviated U character-like slot in a cylinder, and since the sealing nature between a piston and a cylinder is secured, in low speed driving, this method has the merit that efficiency cannot fall easily.

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EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, the invention according to claim 1, The motor element operated with two or more operation frequency which consists of a stator and a rotator and contains the number of rotations of less than commercial power frequency, Support pivotally the principal axis of the crankshaft having the lubricating oil pump which accommodates the compression element driven with the motor element, comprises a principal axis and an eccentric shaft, and is open for free passage to an upside eccentric shaft via an oil supply passage, and a crankshaft, and. It has the cylinder block which has semicircular arc compression space above compression space.
Make a lubricating oil inject towards the semicircular arc notch section provided in the cylinder block from the lubricating oil discharge hole which attracted the lubricating oil and was provided in the upside eccentric shaft with the motor element because a crankshaft rotates, and. An annular oil supply groove is cut in the periphery of a piston, and by a piston bottom dead point, by having set up so that an annular oil supply groove might come out of a semicircular arc notch, by an oil supply groove, since it can supply with oil between a piston and a cylinder, sealing nature can be secured and efficiency always improves.

[0035]When the invention according to claim 2 provided the lubricating oil discharge hole formed in the eccentric shaft upper part of a crankshaft at the invention according to claim 1 in the position of the same height as the semicircular arc notch section provided in the upper wall of the compression space of a cylinder block, Since the lubricating oil injected from the lubricating oil discharge hole always hits a semicircular arc notch section, the quantity of the lubricating oil with which the annular oil supply groove cut in the piston is covered increases, the amount of oil supply between a piston and a cylinder increases, and efficiency increases.
[0036]The invention of this invention according to claim 3 is a case where it is operated with two or more operation frequency which contains the number of rotations not more than 35r/sec in the invention according to claim 1 or 2.
By invention of Claim 1 and Claim 2, since the amount of oil supply between a piston and a cylinder can be increased at the low speed driving time not more than 35r/sec, the efficiency of a low speed driving time improves.

[0037]The invention according to claim 4 establishes further two or more annular oil supply grooves cut in the piston in the invention according to claim 3, and. By having set up so that two or more annular oil supply grooves might come out from the semicircular arc notch section provided in the cylinder upper wall of the cylinder block by a bottom dead point. In the bottom dead point of a piston, two or more cut oil supply grooves are covered with a lubricating oil, and at the time of compression, since the amount of oil supply of a between [a cylinder and pistons] increases further, efficiency increases.

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TECHNICAL PROBLEM

[Problem to be solved by the invention]However, in order to provide an abbreviated U character-like slot in a cylinder, the sealing nature between a piston and a cylinder worsens, and the above-mentioned conventional composition. In a low speed driving time, since the amount of oil supply into a cylinder and the quantity of the lubricating oil injected from the lubricating oil discharge hole of an eccentric shaft decrease, the oil seal nature between a piston and a cylinder gets extremely bad, and there is a fault that efficiency falls.
[0013]In drawing 7, as for a horizontal axis, a vertical axis shows the operating efficiency of a compressor by coefficient-of-performance COP (W/W) with the operation frequency of a compressor. COP shows the characteristic which has the maximal value to operation frequency, and serves as the greatest value in about 40 - 45r/sec. It turns out at the time of low rotation that the operating efficiency of an encapsulated type palace compressor falls remarkably especially at the time of the low rotation not more than 35r/sec. This is considered to be based on the increase in the sliding loss due to the refrigerating capacity fall by the leak of the compressed gas from compression space, or the fall of lubricating oil pump capability.
[0014]On the other hand, since it is not necessary to divide a connecting rod and the assembly ****** does not need to provide an abbreviated U character-like slot in a cylinder, there is a merit that oil seal nature cannot fall easily at a low speed driving time, but since assembly nature is bad and part mark also have it, there is a fault that cost becomes high. [many]
[0015]This invention solves SUBJECT of these former, and it is low cost and aims at providing the encapsulated type electrically-driven compressor which can raise the efficiency at the time of a low speed rotary in the good U character-like slot system of assembly nature.

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MEANS

[Means for solving problem]The motor element operated with two or more operation frequency which the invention of this invention according to claim 1 consists of a stator and a rotator, and contains the number of rotations of less than commercial power frequency, Support pivotally the principal axis of the crankshaft having the lubricating oil pump which accommodates the compression element driven with the motor element, comprises a principal axis and an eccentric shaft, and is open for free passage to an upside eccentric shaft via an oil supply passage, and a crankshaft, and. Because equip the upper wall of compression space with the cylinder block which has semicircular arc compression space and a crankshaft rotates with a motor element. Make a lubricating oil inject towards the semicircular arc notch section which attracted the lubricating oil and was provided in the cylinder block from the upside eccentric shaft, and. Cut an annular oil supply groove in the periphery of a piston, and by a piston bottom dead point. By having set up so that an annular oil supply groove might come out of a semicircular arc notch section, when a piston is a bottom dead point, an oil supply groove is covered with a lubricating oil, and it always has the operation of sending in a lubricating oil between a piston and a cylinder, at the time of compression (top dead center).
[0017]The invention of this invention according to claim 2 the lubricating oil discharge hole formed in the eccentric shaft upper part of a crankshaft to the invention according to claim 1, The lubricating oil injected from the lubricating oil discharge hole of the eccentric shaft by having provided in the position of the same height as the semicircular arc notch section provided in the upper wall of the compression space of a cylinder block on the wall surface of a semicircular arc notch section by that of direct this slack. The quantity of the lubricating oil led to the annular oil supply groove cut in the piston periphery increases, and it has the operation that the amount of oil supply between a piston and a cylinder increases.
[0018]The invention of this invention according to claim 3 Claim 1. Or it is a case where it is operated with two or more operation frequency which contains the number of rotations not more than 35r/sec in the invention according to claim 2, The sealing nature in the compression space of supplying with oil certainly between a piston and a cylinder has especially the operation which suppresses the leak of the compressed gas of ****** at the low speed driving time not more than 35r/sec.
[0019]The invention of this invention according to claim 4 establishes further two or more annular oil supply grooves cut in the piston in the invention according to claim 3, and. By having set up so that two or more annular oil supply grooves might come out from the semicircular arc notch section provided in the cylinder upper wall of the cylinder block by a bottom dead point. Since two or more cut oil supply grooves are covered with a lubricating oil in the bottom dead point of a piston, it has the operation that the sealing nature between a piston and a cylinder improves more, rather than the case of one oil supply groove.
[0020]
[Mode for carrying out the invention]Hereafter, the embodiment of the encapsulated type electrically-driven compressor by this invention is described, referring to Drawings. About the former and an identical configuration, identical codes are attached and detailed explanation is omitted.

[0021](Embodiment 1) Drawing 1 is a view figure [in / the sectional view of the encapsulated type electrically-driven compressor by the embodiment of the invention 1 and drawing 2 can be set in an important section sectional view, and / in drawing 3 / the V-V' line of drawing 2].
[0022]In drawing 1, 1 is a well-closed container and accommodates the motor element 5 which consists of the stator 3 and the rotator 4, and the compression element 6a driven with the motor element 5.
[0023]Next, the details of the compression element 6a are explained below. 7 is a cylinder block and forms the cylinder 13. 8 is a crankshaft, it comprises the principal axis 9 and the eccentric shaft 10, and the lubricating oil pump 18 which is open for free passage to the upper bed of the eccentric shaft 10 via an oil supply passage is built in, and the opening of the lower end is carried out into the oil 2. 11 has connected the eccentric shaft 10 and the piston 23 via the piston pin 12 with the connecting rod. 7a is a slot of the shape of an abbreviated U character which carries out an opening to the cylinder 13 from the upper wall of the cylinder block 7. The connecting rod 11 connected with the piston 23 inserted into the **** compression space 13 and the eccentric shaft 10 is aligned mutually, the piston pin 12 is inserted using the slot 7a, and both are assembled.
[0024]As shown in the eccentric shaft 10 at drawing 2 and drawing 3, the semicircular arc notch section 7c provided in the cylinder 13 is faced, and 10 d of lubricating oil discharge holes are provided in the position of the same height. 20 is the open hole established in the inside of the eccentric shaft 10, one end carries out an opening to the upper bed of the eccentric shaft 10, and the other end is open for free passage to the inclined passage 21 and the lubricating oil pump 18 by the spiral slot 19 formed in the periphery of the principal axis 9. As shown in drawing 4, have cut the annular oil supply groove 23e in the piston 23 at the periphery, and in a bottom dead point. The annular oil supply groove 26e comes out from the semicircular arc notch section 7c thoroughly, and in the time of compression (near a top dead center), the annular oil supply groove 23e has set up go into the semicircular arc notch section 7c thoroughly.
[0025]15 is the valve plate provided with the suction hole, the suction valve, the discharge opening, and the regurgitation valve (neither is illustrated), and closes the end face of the cylinder 13. 16 is the cylinder head divided into the inside at the inhalatorium and the regurgitation room (neither is illustrated), and is fixed to the anti-cylinder 12 side of the valve plate 15. 17 is a suction muffler and is located under the cylinder block 7, It is fixed by being pinched by the valve plate 15 and the cylinder head 16, one end is open for free passage in a cylinder via the valve plate 15, and the other end passes to the opening provided in about 22 suction tube provided in the well-closed container 1. While being fixed to the well-closed container 1 with a suction tube, it is connected to the low-tension side (not shown) of a refrigerating cycle, and 22 draws a refrigerant gas (not shown) in the well-closed container 1.
[0026]About the constituted above encapsulated type electrically-driven compressors, the operation is explained below. The rotator 4 of the motor element 5 rotates the crankshaft 8, and the piston 23 moves the inside of the cylinder 13 reciprocately by movement of the eccentric shaft 10 being told to the piston 23 via the connecting rod 11, Said refrigerant gas drawn in the well-closed container 1 through the suction tube 22 is inhaled from the opening of the suction muffler 17, and is continuously compressed within the cylinder 13.
[0027]On the other hand, if the crankshaft 8 rotates with the motor element 5, the lubricating oil 2 will go up by rotation of the siphon pump 18, and a lubricating oil will be led to the eccentric shaft 10 via the spiral slot 19 and the open hole 20 by the pump action of the inclined passage 21. The lubricating oil led into the eccentric shaft 10 is injected according to a centrifugal force from 10d of lubricating oil discharge holes provided in the eccentric shaft 10. After the lubricating oil injected from 10d of lubricating oil discharge holes hits the side attachment wall of the semicircular arc notch section 7c provided in the upper wall of the cylinder 13 of the cylinder block 7, it flows into the piston upper surface, falls, and carries out the lubrication of between a piston and cylinders.
[0028]In this invention, cut the annular oil supply groove 23e in the periphery of the piston 23, and. By the bottom dead point of a piston, the annular oil supply groove 23e comes out of the semicircular arc notch section 7c provided in the cylinder 13 of the cylinder block 7, and. Since

it has set up so that the annular oil supply groove 23e may go into the semicircular arc notch section 7c thoroughly at the time of compression, After the lubricating oil injected from the lubricating oil discharge hole 10b of the eccentric shaft 10 hits the semicircular arc notch section 7c, a lubricating oil is always led to the upper surface of a piston, and. By the bottom dead point of a piston, the annular oil supply groove 23e established in the outer peripheral part of the piston 23 is always covered with a lubricating oil, and at the time of compression. Since the annular oil supply groove 23e enters into the semicircular arc notch section 7c (compression space), it can stop that the sealing nature between a piston and a cylinder improves and the compressed gas in compression space leaks to the low-tension side in a well-closed container.

[0029]setting to drawing 2 and drawing 3 furthermore — 10 d of lubricating oil discharge holes of the eccentric shaft 10 — the semicircular arc notch 7c — relativity — in a position. And since the lubricating oil injected from the oil discharge hole 10b of the eccentric shaft 10 since it had provided in the same height is always equivalent to the wall surface of the semicircular arc notch 7c, flows into the piston upper surface and falls, The annular oil supply groove 23e cut in the piston 23 is covered with a lubricating oil, and the amount of oil supply between a piston and a cylinder can be increased. The lubricating oil injected from the lubricating oil discharge hole 10b of the eccentric shaft 10 by attaching the angle of about 5-10 degrees to a hand of cut and an opposite direction at 10 d of lubricating oil discharge holes had been equivalent to the semicircular arc notch section 7c wall surface in the piston top dead center conventionally (when an angle is not attached), but. By attaching the angle of about 5-10 degrees, since a lubricating oil always comes to be equivalent to the wall surface of the semicircular arc notch section 7c when a piston is a bottom dead point, the amount of oil supply can be increased further.

[0030]Drawing 4 is the operation frequency and the efficiency characteristic figure of an encapsulated type electrically-driven compressor in the embodiment of the invention 1.

[0031]In drawing 4, as for a horizontal axis, a vertical axis shows the operating efficiency of an encapsulated type electrically-driven compressor by coefficient-of-performance COP (W/W) with the operation frequency of an encapsulated type electrically-driven compressor. The encapsulated type electrically-driven compressor of the former [dashed line] and a solid line show the characteristic of the encapsulated type electrically-driven compressor of this invention, respectively. Although COP has the maximal value to operation frequency in both sides, the characteristic which is excellent in the coefficient of performance of the compressor of this invention covering whole drive frequency, and excelled about 35 (r/sec) in this invention by the difference of both characteristics becoming large at the time of low rotation is seen.

[0032]Since the quantity of the lubricating oil which the oil supply capability of a lubricating oil pump declines, and is injected from 10d of lubricating oil discharge holes of the eccentric shaft 10 when number of rotations becomes low will also become less by the inverter control of a compressor if it operates at the number of rotations not more than 35r/sec, the oil seal nature between a piston and a cylinder gets worse. Since the compression time required is prolonged because the period time of piston reciprocation becomes long, the amount of leaks of the compressed gas of compression space also increases, Although compressor efficiency falls from the fall of refrigerating capacity, since the amount of oil supply of a between [piston cylinders] can be increased also in the time of a low speed by ensuring oil supply to a notch section and cutting an oil supply groove in a piston periphery, the operating efficiency of a compressor improves.

[0033](Embodiment 2) Drawing 5 is an enlarged drawing of the piston of the encapsulated type electrically-driven compressor in the embodiment of the invention 2. 23a is a piston and two or more annular oil supply grooves 23e on the periphery near the end face with grooving. Since it has set up by the bottom dead point of the piston so that two or more oil supply grooves 23e may come out, Since two or more crevices are covered with it in a bottom dead point after the lubricating oil injected from that of the eccentric shaft 10 is equivalent to the wall surface of the semicircular arc notch 7c, the sealing nature of compression space improves more by increasing further the amount of oil supply to a piston and a cylinder.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The sectional view of the encapsulated type electrically-driven compressor of Embodiment 1 in this invention
[Drawing 2]The important section sectional view of the encapsulated type electrically-driven compressor of the Embodiment 1
[Drawing 3]The view figure in the V-V' line of the Embodiment 1
[Drawing 4]The characteristic figure showing the operation frequency and efficiency of an encapsulated type electrically-driven compressor of the Embodiment 1
[Drawing 5]The piston enlarged drawing of the encapsulated type electrically-driven compressor of Embodiment 2 in this invention
[Drawing 6]The sectional view of the conventional encapsulated type electrically-driven compressor
[Drawing 7]The characteristic figure showing the conventional operation frequency and efficiency of an encapsulated type electrically-driven compressor
[Explanations of letters or numerals]
1 Well-closed container
2 Lubricating oil
5 Motor element
6a Compression element
7 Block
7c A semicircular arc notch section
8 Crankshaft
9 Principal axis
10 Eccentric shaft
10 d Lubricating oil discharge hole
11 Connecting rod
12 Piston pin
13 Cylinder
18 Lubricating oil pump
19 Oil passage
23 Piston
23e An annular oil supply groove

[Translation done.]

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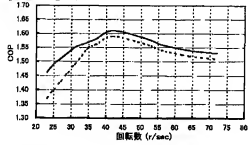
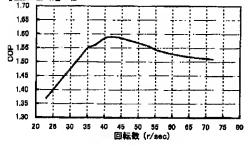
DRAWINGS

[Drawing 4]

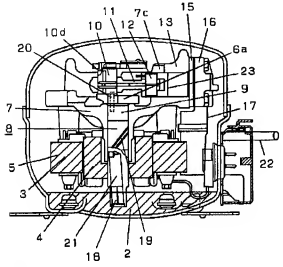


[Drawing 7]



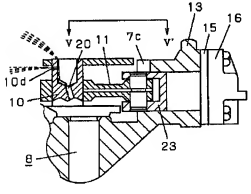
[Drawing 1]

2 潤滑油
5 電動要素
6a 圧縮要素
7 シリンダブロック
7c 切り欠き部
8 クランクシャフト
9 主軸
10 偏心軸
11 コンロッド
12 ピストンピン
13 シリンダ
16 オイルポンプ
23 ピストン



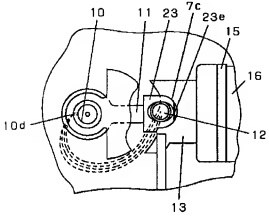
[Drawing 2]

7c 切り欠き部
8 クランクシャフト
10d 潤滑油放出孔
13 シリンダ
23 ピストン



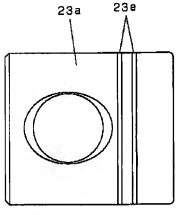
[Drawing 3]

7c 円弧状の切り欠き部
23e 環状の給油溝

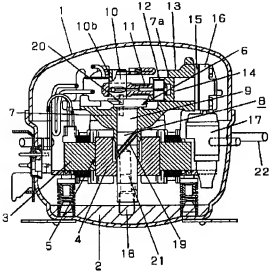


[Drawing 5]

23a ピストン
23e 環状の給油溝



[Drawing 6]



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